REMARKS

Amendments

Claims

Claim 1 has been amended to more particularly point out and distinctly claim the subject matter applicants regard as the invention. The claim clarifies that the superconducting coil is made only of superconducting wires housed in a metal conduit without pure copper wires. The claims now also clearly recites that the normal conducting coil is electrically coupled to the superconducting coil and allows a portion of the current flow to bypass the superconducting coil by induction. Also, the claim now clearly recites that the superconducting coil and the non-superconducting coil are arranged separately in a coil case.

These amendments are supported throughout the specification at page 4, lines 15-29, and page 5, lines 24-28, and particularly by Figure 3. Applicants respectfully submit that the amendment adds no new matter to the application and earnestly solicit entry thereof.

Drawings

Figures 1, 2, and 4a have been labeled "Prior Art," consistent with the description of these Figures in the specification. Applicants respectfully submit that these amendments add no new matter to the specification and earnestly solicit entry thereof.

The Invention

The claims are directed to a superconducting coil system comprising a superconducting coil and a normal conducting coil arranged separately in a coil case. The superconducting coil is made solely of superconducting wires housed in a metal conduit without pure copper wires. The normal conducting coil is electrically coupled to the superconducting coil, allowing a portion of the current flow to bypass the superconducting coil by induction. The normal conducting coil

has a current time constant L_2/R_2 larger than L_1/R_1, the time constant at which the current through the superconducting coil decays rapidly after the conductors in the superconducting coil made a transition to the normal conducting state. Herein, L_1 and L_2 represent the self-inductances of the superconducting coil and the normal conducting coil, respectively, R_1 represents the resistance for causing rapid decay of the current flow through the superconducting coil, and R_2 represents the resistance of the normal conducting coil.

The Office Action

Drawing Figures 1a-2 and 4a were properly identified as prior art in the specification, but were not so labeled.

Claims 1-2 and 7-9 stand rejected under 35 U.S.C. § 102(b) as anticipated by allegedly admitted prior art. The office action asserts that pages 3-4 of the specification acknowledge that "the transition of the superconductive cable from a superconductive state to a normal state is arranged such that the current time constant L/R of the non-superconducting wire is larger than that of the superconducting wire, see figure 4a and 4b (showing the L/R of the superconducting wire)."

Claims 2, 6, 8, and 10 stand objected to as dependent upon a rejected base clam, but allowable if rewritten. Whereas claims 2 and 8 are both rejected and objected to, claim 5 was not addressed at all.

Remarks

Applicants respectfully traverse the rejection of claims under 35 U.S.C. § 102(b) based on an alleged admission. The office action apparently relies upon disclosure said to be found at pages 3-4 of the specification, but the teachings relied on and identified as prior art are not found anywhere in the specification. Indeed, one of the drawing figures relied upon in this argument,

Fig. 4b, is not prior art, but rather illustrates properties and characteristics of the claimed invention.

The rejection relies on an alleged teaching at pages 3-4 of the specification that "the transition of the superconductive cable from a superconductive state to a normal state is arranged such that the current time constant L/R of the non-superconducting wire is larger than that of the superconducting wire, see figure 4a and 4b (showing the L/R of the superconducting wire)." However, this portion of the specification includes descriptions of Figures 2-4 and the detailed description of the invention. The relevant disclosure about the prior art relates to CIC (cable-in-conduit) superconducting coils having pure copper wires to carry a bypass current in case a live superconducting wire makes a transition to normal conducting. This section of the specification also describes the invention, a superconducting coil without pure copper wires. The invention is illustrated in Figs. 3a and 3b, and is further described as comprising "a superconducting coil solely fabricated of cable-in-conduit conductors without pure copper wires and a normal conducting coil which allows a portion of current flow to bypass the superconducting coil by induction."

The office action also apparently relies on Fig. 4b as evidence of the allegedly admitted prior art. However, Fig. 4b is clearly described in the specification as illustrating the current flow history of a coil system of the invention. Therefore, it cannot be considered to be illustrative of or demonstrating the prior art.

Applicants respectfully submit that, contrary to the assertion in the Office Action, Figs. 1, 2, and 4a, which illustrate the prior art, contain no description or suggestion that the current time constant of the normal conducting coil (L_2/R_2) is larger than that of the superconducting coil (L_1/R_1). The superconducting coil system of the prior art does not comprise a normal conducting

coil. Therefore, the time constant of the superconducting coil (L_1/R_1) cannot be defined by any means.

Applicants respectfully submit that the superconducting coil system of the prior art is illustrated in Figure 1 and explained at least at page 1, lines 6 to 23 of the specification. In the prior coil system, a winding of superconductors is housed in a coil case (Figure lb). The superconductors are constructed so that superconducting wires are housed in a metal conduit with pure copper wires (Figure la). Further, as described at page 3 of the specification, the pure copper wires "carry a bypass current if the live superconductor makes a transition to the normal conducting state, so that the temperature of the superconductor will not become higher than a certain level (typically 250 K) due to Joule's heat." These pure copper wires are found in the superconducting coil. Importantly, the prior art system is devoid of a normal conducting coil.

In contradistinction, the present invention reduces the conductor size in a superconducting coil system by removing the pure copper wires from the superconductor.

As set forth in amended claim 1, the inventive superconducting coil system comprises a superconducting coil and a normal conducting coil. The superconducting coil and the normal conducting coil are arranged separately in a coil case. The superconducting coil is made solely of superconducting wires, without pure copper wires, housed in a metal conduit. The normal conducting coil is electrically coupled to the superconducting coil and allows a portion of current flow to bypass the superconducting coil by induction. The normal conducting coil has a current time constant (L_2/R_2) which is larger than that of the superconducting coil (L_1/R_1).

Thus, the claimed invention is distinguished from the prior art for at least the following reasons:

- the inventive coil system comprises a normal conducting coil which is not a constituent of the prior coil system;
- the superconducting coil of the inventive coil system does not comprise pure copper wires which are constituents of the prior coil system; and
- the normal conducting coil has a current time constant (L_2/R_2) which is larger than that of the superconducting coil.

Applicants respectfully submit that there is no disclosure or suggestion in the prior art that, by virtue of this particular time constant condition, a normal conducting coil allows a portion of current flow to bypass the superconducting coil by induction.

Further, the Office Action asserts that Applicants acknowledge in the specification (pages 3-4) that "the transition of the superconductive cable from a superconductive state to a normal state is arranged such that the current time constant L/R of the non-superconducting wire is larger than that of the superconducting wire."

However, Applicants respectfully submit that the self-inductance (L) and the resistance (R) are parameters used to characterize a coil, not a wire and cable. Thus, Applicants respectfully assert that this rejection is not well-founded because these parameters are applied to a wire and cable in the rejection. Further, in a superconducting coil system consisting of superconductor in which superconducting wires are housed in a metal conduit with pure copper wires, it is impossible to define the current time constant of each of the non-superconducting wires (pure copper wires) and the superconducting wire, as explained in detail below.

The office action apparently relies on Figure 4b in making this rejection. However, Figure 4b illustrates the current flow history of the inventive coil systems when the current through the superconducting coil is rapidly diminished to zero. In Figure 4b, after a certain time

passes (about 1 second), the current flowing through the normal conducting coil is increased from zero, and simultaneously, the current flowing through the superconducting coil is decreased to nearly zero. Thereafter, the current flowing through the normal conducting coil decreases with time. Specifically, in the inventive superconducting coil system, approximately the entire current flow is substantially switched from the superconducting coil to the normal conducting coil.

On the other hand, Figure 4a illustrates the current flow history of the prior art superconducting coil consisting of one superconducting coil. In general, the current flows through the superconducting wires, not through the pure copper wires. As illustrated in Figure 2, when the superconducting wire makes a transition to the normal conducting state over a certain length, a portion of the current flow corresponding to the length diverges into the pure copper wire. However, even in this case, the current flow does not appear over a major part of the length of pure copper wire. Therefore, in the prior superconducting coil system, it is impossible to define the current flow through each of the superconducting wire and pure copper wire over their entire lengths. The current history of the prior art coil system is determined by the inductance (L) of the superconducting coil and the external resistance (R) coupled to the superconducting coil.

L and R are parameters, not for a wire and cable, but for a coil, as stated above. Further, it is impossible to separate the prior art superconducting coil system into two coils, one of non-superconducting wires (pure copper wires) and the other of the superconducting wires, because the current flow is not uniform over the entire length of each of the non-superconducting wires and the superconducting wires. In other words, the current flow through the superconductor

flows into the superconducting wires over a major part of the length of superconductor and into the pure copper wires over only a certain length of the superconductor.

The feature that the normal conducting coil has a larger current time constant than the superconducting coil can be obtained only when the superconducting coil and the normal conducting coil are arranged separately in a coil case, as in the claimed invention. The feature cannot be obtained by a construction having superconducting wires and non-superconducting wires (pure copper wires) in the same metal conduit, as in the prior art.

The prior art made of record and not relied on neither suggests nor discloses the claimed invention, whether considered alone or in combination.

CONCLUSION

Applicants respectfully traverse the rejection based on 35 U.S.C. § 102(b). The prior art described in the specification and in the drawing figures directed to the prior art does not disclose or suggest the claimed invention.

Applicants respectfully submit that the claims are in condition for allowance and earnestly solicit favorable action thereon.

Respectfully submitted,

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Amendments to Drawing Figures:

Applicant submits herewith corrected formal drawing sheets of Figures 1a-2 and 4a. As identified in the office action, these drawing figures depict the prior art, and have been annotated to so indicate.

Attachments: Annotated and corrected formal drawings.